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NATURAL HISTORY IN THE GRADES

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II. SECOND GRADE

For a brief statement of the general plan of organizing the work in natural history for the grades the reader is referred to the November *Elementary School Teacher*. In each article of this series, in addition to outlining the materials to be used in the grade under discussion, some of those materials will be selected for a more detailed treatment in order that the method of work may be indicated. In the last article, the garden work, earth materials, and climatology were selected for detailed suggestions and the directions there given should be kept in mind in following up the work in those subjects in succeeding grades, though later further details will be given. In the Second-Grade outline, after the statement of topics to be included, the work in animal life is discussed more at length.

It must be kept in mind that the "what" and "why" attitude of the First Grade still is dominant in this grade, but work that is somewhat more prolonged and a little more investigative in character may well be undertaken. The First-Grade acquaintances in nature should be reviewed, and used as the starting-point, and subsequently used for constant reference. Indeed all First-Grade topics should at some time be used again in the Second Grade, else they will be forgotten. Repetition is essential, but this repetition now comes in connection with and as the basis of new work. The following materials are used in this grade:

New York Public Library, Fullerton Branch, 1st and Hill Ave. Circulation Department

1. *Animal life.*—A pair of rabbits, or a pair of nesting pigeons or doves; life cycle of the toad; blue-bird, red-headed woodpecker, grackle, junco, yellow warbler, gulls, the passing of wild ducks and geese, birds that remain through the winter, nesting habits of robin and English sparrow; dragon-fly, honey-bee, bumble-bee, wasp and nest, ants and nest, and the community life and activities of insects; caterpillar, cocoon, and adult butterfly or moth; grow in the room any common butterfly or moth through its life cycle, or a silkworm and moth in case such is available.

2. *Plant life.*—Plants of the farm such as corn, wheat, oats, millet, rice, and the materials derived from these that are used by man and his domesticated animals; sunflower, wild aster, golden-rod, cat-tails, water lily, plantain, thistle, evening-primrose, ash, cottonwood, hickory, black walnut, pine; seeds of several kinds of common plants; the fruits of wild plants, such as grapes, cherries, Indian currant, and nuts.

3. *Garden work.*—Window boxes containing house plants and a box or bed of bulbs some of which are different from those grown in the First Grade. Indoor gardening should be carried on throughout the year. In the outdoor garden the children of this grade should have one group garden or a few group gardens each in charge of a smaller group of pupils. Children of this grade should do their own planting and cultivation. The plants used should include some of those grown by First-Grade pupils but also some additional ones. The addition of a few of the less common plants as gourds and peanuts add interest. If three or four group gardens are used, interest is increased by having one group grow house plants—geranium, nasturtium, Coleus—another, radish, lettuce, and beets, another, pumpkins, another gourds, and another peanuts. Records of the garden work should constantly be made in written work and in sketches.

4. *Earth materials.*—Action of waves upon stones and sand, weight of stones as compared with water and wood studied by weighing and by displacement, and their properties such as hardness, color, and composition. Each child should be encouraged to make a collection of stones of different kinds.

5. *Physical and meteorological materials.*—In connection with the study of earth materials are included elementary experiments and observations upon physical and meteorological phenomena associated with changes in the condition of materials. These include a study of water, steam, fog, clouds, dew, rain, snow, frost, hail, ice, air, and air currents. The plan for study of climatology in the preceding year may again be used advantageously in this connection, but the work should be based upon schoolroom experiments in evaporation, boiling, and condensation, and upon careful observations of out-of-door phenomena.

In addition to acquaintanceship with all the animals included under "animal life," and some knowledge of their homes and habits there is made a careful study of the more conspicuous features of three life cycles—that of a dove or pigeon, of a moth or butterfly, and of the toad. As will appear in discussions of the outline for succeeding grades, there is arranged a series of life cycles of increasing complexity, so that there may be developed in a logical and natural way an understanding of the significance of the life round from one generation to another. To this end a pair of tame birds as pigeons or doves may be kept within the room and observed through all the nest building processes. We have had several pigeon nests built while under constant observation by children, and with never-ending interest on the part of all who observed the process. Indeed, old and young students find something new in the habits of each pair of these birds as they build their nests. Immediately following the completion of the nest, sometimes before, there appear the eggs, first one, then the second, and the period of incubation has begun. Questions such as the following help to give the study definiteness and also to insure that important points will not be omitted. Such questions do not remove opportunity for spontaneity in observation. In answering these questions the children should place on the board or upon a special pigeon-nest-calendar the dates and times of day on which various events are observed. Accurate records have great value in such work. Did incubation begin before the second egg was laid? How many days were used in building the nest? How many until egg laying was

finished? How many were consumed in incubation before the first young were hatched? Did both young birds hatch on the same day?

During the period of incubation there are also many things to be observed, as: Does one parent do all the sitting? If not, do they divide the time equally? Do they behave in the same way? Does one parent ever feed the other? Do they "handle" their eggs in any way? Do they repair their nest while sitting? Do they make the same sounds while sitting as before? Do they eat as before? How do they behave when the young birds begin to hatch? How do the young birds get out of the shells of the eggs? What is the appearance of the old shell? How do the parents feed the young birds? Do both parents feed them? When do the first feathers appear? When do the young birds first stand up? How do they act? When do they leave the nest? While studying these and similar questions records should constantly be kept on the chart, by means of simply written stories, by numerous sketches, and sometimes by modeling in clay.

Not infrequently a robin or other common bird may nest upon a window ledge or so close to the schoolroom that it may be studied, though rarely would its nest enable pupils to observe closely enough to answer many of the above questions. (For suggestions upon the study of a robin's nest see an article by Jessie R. Mann in *The Nature Study Review*, Vol. IV, No. 9, pp. 265–71.)

Another life-cycle study used in this grade is that of the moth or butterfly. This is best studied by use of one of the larger moths as the Cecropia whose caterpillar stage often may be found in the autumn after the opening of school. The feeding habits of this caterpillar are so ravenous that children are stimulated to extreme interest in observing it, and in attending to its needs. The caterpillars may readily be removed from the plants upon which they are feeding (often the willow) and carried to the schoolroom. A supply of leaves of the kind that were being used as food should also be taken, though these must be replenished daily in order that fresh food may be had.

Various kinds of cages may be used. A pasteboard box with holes punched in the cover and sides is sometimes used, this

having the disadvantage of darkness and difficulty of maintaining cleanliness. A small wooden box with wire or cloth netting over the top makes a better cage, but better than either of these is one constructed by use of a lamp chimney. Over the top of a large lamp chimney (the larger the better) tie a piece of netting, this being for ventilation. In a glass dish or earthen pot put one and a half or two inches of sand or porous soil. Upon the sand place the lower end of the lamp chimney. The sand or loose soil will absorb the moisture of the excretions from the caterpillar and by being renewed every two or three days enables the children to keep the cage attractive.

When placing the caterpillars within this cage put in a few twigs bearing the kind of leaves which are known to serve as food, inserting the base of the twigs into a small bottle or dish of water. Several kinds of willow leaves serve well as food for the Cecropia caterpillar. In connection with feeding these insects, interesting experiments may be made to determine the quantity of food eaten in a given length of time. Count and weigh the leaves put into the cage in one day. Also weigh the caterpillar in the morning before putting in the fresh leaves, and by weighing the caterpillar and the leaves that are left see how the weight of food eaten by it in one day compares with its own weight. A liberal supply of leaves should be put into the cage since the caterpillar eats almost constantly during the day. Does it eat at night?

Immediately before the period of cocoon spinning the caterpillar is likely to be rather sluggish. Constant watch should be made for the beginning of spinning, since it is a sight of extreme interest and instructiveness. From the appearance of the first threads of silk until the cocoon is complete may sometimes be a surprisingly short time—an hour or two—or it may be prolonged throughout a day. The pupils should see as much as possible of this process, and the gradual disappearance of the caterpillar within his cocoon, else the future developments will be unrelated to things already seen. Indeed to many grown-ups the performance of the apparent impossibility of development of the large, highly decorated and striking form of the adult moth from the caterpillar or from the apparently dead cocoon and contents

(chrysalis) is a never-ending surprise. It is one of the wonders of nature's truths, no less wonderful than many improvised and truthless stories of nature.

The cocoons should be placed where they may remain undisturbed until the moth emerges. Especially must there be no handling of the cocoon during the first stages of the emergence of the moth, since at such a time it may very easily be killed. Should both male and female moths be secured it is possible to keep them in a cage—a cage at least a foot or more in inside dimensions—to secure the eggs. If these may be placed upon proper kinds of leaves the young caterpillars may be secured and observed through the earlier stages of their development.

A third life-cycle study suggested for this grade is that of the toad. In the first grade the toad was studied in so far as its ways of living and habits in general could be observed. The acquaintance thus developed is used in early spring in the Second Grade as the beginning point at the time when frog's eggs begin to appear in ponds and along banks of streams. Collect these eggs (the toad's eggs are in strings, the frog's in clumps or masses) and place in an aquarium in the schoolroom. The water in the aquarium must be shallow or aeration must be had by blowing air into the water several times per day. If abundant plant material is growing in the aquarium sufficient oxygen will be produced, and also sufficient slime to nourish the hatching tadpoles for a time. If not too many are placed in one aquarium (25 to 40 tadpoles may be kept in a dish one foot in diameter) they will be able to get sufficient food from slime and small plants that should be secured from ponds or streams and placed in the aquarium at intervals of two or three days. Careful observation should be made concerning the development, movement, and feeding habits and these should be recorded in written work, stories, and drawings. One pupil has prepared a clay model life-history series of the toad which illustrates admirably the changes that occur throughout the entire development. Excellent suggestions and directions for the carrying-on of work with the toad may be found in a pamphlet by S. H. Gage, *Teachers' Leaflets*, No. 9, College of Agriculture, Ithaca, N. Y., and in pp. 274–94 in Hodge's *Nature Study and Life*.

AGRICULTURAL EDUCATION

UNITED STATES BUREAU OF EDUCATION. STATE DEPARTMENTS OF EDUCATION. STATE LEGISLATION

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UNITED STATES BUREAU OF EDUCATION

Agricultural education receives the attention of the Bureau of Education in several ways. These may conveniently be grouped under three heads: publications, land-grant colleges, and legislation.

Having little administrative authority except that relating to land-grant colleges the Bureau has confined its efforts mainly to its publications and correspondence. "No other educational office of the world has done so extensive literary work as this office," is the fine tribute paid by the Royal Prussian Commission of 1904 in its report to the Prussian Parliament. The Bureau's publications consist of annual reports, special reports, circulars of information, and bulletins.

The policy of the bureau toward agricultural education recently expressed by the commissioner applies especially to its publications:

> It can do its best I think as a co-ordinating influence. It can bring to the notice of less favored institutions information concerning the experience of more advanced institutions. It can call attention from time to time to the relation of agricultural education to general education. It can survey the educational field and possibly point out dangers to be averted or weak places to be strengthened. It can, finally, discover things that need doing and are not attended to by any other agency, and can see that some part of such lack is supplied. So much as this I hope the Bureau of Education may be able to do for agricultural education. And so much as this, I may say, it will undertake to do as far as its resources will permit (18, p. 53).

The Bureau has done much already in two ways: one by bringing to American educators the work of foreign countries, and the other by reviewing the work being done in various parts

of this country. Of the former the most important are the accounts of agricultural education in Austria, Belgium, Canada, France, Germany, Great Britain, and Prussia. One of these publications on school gardens, deserves special mention (19). It contains a very complete historical account of school gardens and has been extensively quoted in the school-garden literature of this country. Of the reviews of work in our own country two are noteworthy. One written at the beginning of the movement for instruction in elementary agriculture is made up chiefly of reprints of leaflets from Purdue and Cornell Universities (20). The other, appearing in 1907, gives an account of the present status of agricultural education throughout the world (21).

The first Morrill Act of 1862, the second Morrill Act of 1890, and the Nelson Act of 1907 providing for government aid to agricultural and mechanical colleges are administered by the Department of the Interior (17, p. 31).

> The annual payments under the acts of 1890 and 1907, are made on certifications of the Secretary of the Interior, which are based upon the proper expenditure of preceding appropriations. All of these reports required to be made by the act are collected and passed upon by the Commissioner of Education, upon whose recommendation is based the action of the secretary (17, p. 32).

While the duties of the Commissioner of Education in his relation to land-grant colleges consist chiefly in gathering statistics and making reports to the Secretary of the Interior he has opportunities for making suggestions and recommendations of importance to agricultural education. For example, in his letter of April 17, 1907, to the presidents and boards of control of state colleges of agriculture and mechanic arts he calls attention to a provision of the act of 1907 "providing for courses for special preparation of instructors for teaching the elements of agriculture and mechanic arts" and adds, "With the increasing number of secondary schools of agriculture and of industrial and trade schools, there will arise a considerable demand for specially prepared teachers to give instruction in special branches of study" (22, p. 870). In his report of 1908 to the Secretary of the Interior he gives an account of the action of several institutions taking advantage of this provision (23, pp. 740, 741).

On July 1, 1909, the Bureau appointed a specialist in land-grant college statistics who is expected also to pay attention to the general subject of agricultural education and to be able to furnish information and advice concerning that subject.

The Commissioner of Education holds an important advisory position with reference to any proposed national legislation concerning education, particularly agricultural education. During the sixtieth session of Congress several bills were introduced providing for national aid to education in agriculture and other industrial subjects. Of these the most important were the Burkett bill (S. 3,392) providing for "the advancement of instruction in agriculture, manual training, and home economics in the state normal schools of the United States," and the Davis bill (H. R. 534) providing in a similar way for national aid to agricultural and industrial education in the secondary schools only. The latter was finally revised (H. R. 18,204) so as to include the provisions of the Burkett bill (S. 3,392).

The Davis bill provides for annual appropriation of "ten cents per capita of the population of each state and territory and the District of Columbia" for aid to maintain instruction in agriculture and home economics in agriculture schools of secondary grade, and an appropriation of one cent per capita to maintain similar instruction in state and territorial normal schools (24, pp 85–87).

The large amount of money concerned, and the establishment of separate schools not already a part of our national system of education called for careful study and deliberation. The Bureau of Education was freely consulted in the matter. No one had a clearer insight into the far-reaching influence of the bill, a clearer understanding of its importance upon the economic and educational welfare of the nation, or a greater appreciation of the principles involved in such legislation, than the Commissioner of Education. In a letter dated September 26, 1907, to Mr. Davis he says:

> One strong argument in favor of such national aid, when extended to special forms of education which are in special need of encouragement, may be drawn from the workings of the appropriation for support of land-grant

colleges, contained in the second Morrill Act of August 30, 1890. The recent effect of the national appropriations under that act has been to stimulate greatly the support of the land-grant colleges by the states in which they are situated.

He calls attention to a provision of the measure giving administrative authority over the appropriations therein provided to the Department of Agriculture, whereas "appropriations which are primarily for agriculture are now administered by the Department of Agriculture, and these which are primarily for education (land-grant colleges) are administered by the Bureau of Education."

I think [he says] as matters now stand this is a good working division, particularly as the relations between the Bureau of Education and the Office of Experiment Stations of the Department of Agriculture are very close and cordial. Educational interests are becoming so strongly unified throughout this country, and in fact in foreign lands, that the present tendency points to unifying of government activities of a purely educational sort, or of predominantly educational sort, under the Office of Education. Another reason for bringing the activities provided in your bill under the Bureau of Education is that they deal not only with agricultural high schools but with high schools of mechanic arts in cities as well. In institutions of both classes, while industrial ends are sought and industrial means employed, the main purpose, as I understand it, is educational.

It seems to me worth considering, also, the question whether it is advisable that rural schools, to which the bill relates, should in all cases be designated as agricultural high schools. There is still a good deal of difference of opinion as to whether high-school work in agriculture may be done to best advantage in general high schools which are properly equipped on the agricultural side, or in agricultural high schools which pay incidental attention to studies other than agriculture. It is likely, in fact, that we shall have institutions of both types for many years to come, and that both of them will do good and efficient work in the promotion of agricultural education. For this reason it seems to me doubtful whether it is wise to limit the distribution of the fund by using the distinctive designation of agricultural high school.

In a letter to Senator Proctor, dated March 4, 1908, the whole matter of national aid as proposed by the Burkett bill and by the Davis bill is carefully reviewed. The entire letter should be read in order to form a just conclusion of the Commissioner's position. After citing the difficulties arising from our complex industrial

situation, both urban and rural, he recognizes the probable need of federal aid in the following words:

> For all these reasons (referring to our industrial situation) the problem of a better education of an industrial type, in both country and city, has steadily become more acute. It is extremely doubtful whether these growing needs can be met in the near future in the majority of the states, unless the encouragement of federal appropriations be added to the efforts of the states and of local communities.

While approving the measure in principle he urges "that any forward step which the national government may take in the encouragement of public education should be carefully weighed, and given its proper place in a well-digested general policy." Furthermore, the conditions in several states are widely different, and any bill should be framed with a full knowledge of these differing conditions in order that it may be made sufficiently flexible to accomplish the best results in all parts of the country. In order "to make possible for Congress to act on bills like S. 3,392 with full knowledge of the situation and needs of the country" he recommends that a commission be appointed to make a thorough investigation of the question and "report to Congress on or before January 1, 1910."[1]

Neither the Davis bill nor the Commissioner's recommendation became a law. The bill was an indication of the interest of the country at large in extending agricultural education into the elementary and secondary schools. The attitude of the Bureau of Education was one of accord with the general principles on which the measure was based, but at the same time one of caution, recognizing that national appropriation to agricultural education, when given, should be of the greatest possible service.

STATE DEPARTMENTS OF EDUCATION AND STATE LEGISLATION

Each state or territory has at the head of its school system a central office. This office is administered in most states by a state superintendent or state commissioner of education, and in

[1] For permission to quote from letters to Congressman Davis and Senator Proctor, and for other assistance in getting material for this paper, the writer is indebted to Commissioner Elmer Ellsworth Brown. A portion of his letter to Senator Proctor appears in the Commissioner's *Report* of 1908.

some states, as in Connecticut, Delaware, Rhode Island, and Massachusetts, by a state board of education through its secretary or commissioner (25).

These state offices vary in details and plan of organization, and somewhat in authority over educational matters, but are alike in essential respects. But however efficient the departmental organizations, the personality and aggressiveness of those in charge count for much in the influence that these offices exert in the educational welfare of their respective states.

It is especially true that the introduction of a new subject of instruction like agriculture may be greatly hindered or promoted by the attitude taken by the state office. If favorable, the subject may be recommended for legislation, it may be put in the course of study, a textbook may be adopted, through personal influence on local boards it may be introduced in certain sections of the state, interest may be aroused by making it a reading-circle subject, special publications may be issued to help teachers who wish to teach the subject, by promoting interest through clubs or other organizations. The main facts concerning the efforts of all the states and territories in the promotion of agricultural education in the elementary and secondary schools through their central offices of education and by legislation are indicated in the following tabulation.

In Delaware and Nevada interest in agricultural education has not seemed to warrant any attention from their state departments of education. Kentucky, although an agricultural state, has apparently shown much less interest in agricultural education than have other southern states. This may be readily explained by the fact that until 1908 the public-school system was organized under the old district plan. The schools were practically controlled by about 25,000 school trustees, 5,000 of whom could neither read nor write. The action of the legislature of 1908 has changed the whole aspect of the Kentucky educational situation, and already remarkable progress has been made toward the improvement of her public schools.

A glance at the tabulation shows that the southern states have been more active (at least recently) in the promotion of agri-

cultural education than the northern states. This activity is a part of the general educational movement extending throughout the South. Educational campaigns have recently been conducted in several of these states and have done much to increase interest in all educational matters.

The earliest legislation concerning introduction of agriculture into elementary schools was the Nixon law of New York in 1897 (20, 1610–14). It provided for the extension of agriculture into the public schools under the direction of the Agricultural College of Cornell University. It was carried out by means of visits to schools and lectures before teachers' institutes, and by means of teachers' and pupils' leaflets for use in rural schools. The Cornell leaflets not only stimulated much interest in elementary agriculture and nature-study in the state of New York but in other states as well. Similar publications have since been issued by agricultural colleges of several other states.

Requiring the teaching of elementary agriculture by law has not met with unqualified success. In some states where it is supposed to be in force little attention is paid to it on account of lack of qualified teachers. The establishment of state secondary schools of agriculture and provision for state aid to high schools teaching agriculture is probably the most important recent legislation concerning agricultural education. The latter form of state aid seems to be growing in favor.[2]

Courses of study vary much in their treatment of agriculture as a school subject. The newness of the subject is usually recognized by special directions and suggestions for teaching. These are generally given in a state school manual or handbook for teachers. In some states they are in separate publications. In New York, for example, suggestions are outlined in syllabi, one for elementary schools and one for high schools. In other states bulletins on certain phases of the subject are issued, as in Michigan.

Perhaps the most significant fact showing the widespread general interest in agricultural education in elementary and sec-

[2] The subject of agricultural secondary schools will be taken up in detail in a later paper of this series.

ATTITUDE OF STATES TOWARD AGRICULTURAL EDUCATION IN ELEMENTARY AND SECONDARY SCHOOLS

LEGISLATION AND STATE DEPARTMENTS OF EDUCATION

States	Required by Law	When Passed	Agr. High Schools	Teachers' Examination	Text-book	Course of Study	Reading Circle	Special Aid	Recommendations	Addenda	Addenda
Alabama	Yes	1903	9 Districts each $4500 per year	Yes	Yes	Yes	.....	.....	To be given in H. S. receiving state aid	$2,000 state aid to H. S., but each must have 5 acres of land	
Arizona	.....	....	.....	.....	.....	.....	.....	.....	Favorable	Probably be taken up by next legislature	
Arkansas	Yes	1909	4, $160,000 appropriated, 1909	After 1910	.....	.....	.....	Organization of boys' corn clubs	Favorable	.....	.....
California	Agricultural nature-study	1907	2, 1903 and 1907	.....	By counties	Optional	.....	Bulletins	Urges school gardens and agr. clubs	.....	.....
Colorado	.....	....	.....	.....	.....	.....	Yes, 1908	.....	School gardens	State supt. favors legislation	.....
Connecticut	.....	....	.....	.....	.....	.....	.....	Directions for teaching agr., 1903, '06, '07, '08	By educational commission, 1907	.....	.....
Delaware	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Florida	Yes	1909	.....	Yes	Yes, 1909	8 grade	.....	.....	Favorable	$65,000 for state aid to H. S., 1907, course of study to include agr.	.....
Georgia	Yes	1903	11 District H. S. $77,000 1906	Yes	Yes, 1908	4–7 grades	.....	Educational campaign; Cirs. to co. supts.	Favorable	Legislature of 1907 recommended to Congress that Davis bill be passed	.....
Idaho	.....	....	.....	.....	Yes, 1907	7–8 grades School gardens	.....	Teachers' manual	Favorable	.....	.....

Illinois	.....	....	.....	.....	.....	8 grade	Yes, 1908	Special buls. Mo. press bul. State manual	Favorable	.....	.....
Indiana	.....	....	.....	.....	.....	7–8 grades	Yes, 1909	Buls. Manual	Favorable	.....	.....
Iowa	.....	....	.....	.....	.....	.....	.....	.....	Favorable	Appropriation for extension work in agr. including teaching, 1907	Bill to require agr. ed. in all accredited colleges nearly passed in 1907
Kansas	.....	....	.....	Recommended to legislature by commission of 1908	Yes	8 grade H. S.	.....	Manual	Favorable	.....	.....
Kentucky	.....	....	.....	.....	.....	.....	.....	Educational campaign	Favorable	.....	.....
Louisiana	Yes	1898	10, 1909	.....	.....	H. S. correlated with other sciences	.....	Organization of agr. H. S.	Favorable	.....	.....
Maine	Forestry	1903	.....	Yes	.....	H. S.	.....	.....	Favorable	One-half expense for agr. teaching by incorporated academies to be paid by state, 1909	.....
Maryland	Yes, at discretion of State Board	1904	.....	.....	.....	7 grade	Yes, 1902 1908	Teachers' Yearbook	Favorable	.....	.....
Massachusetts	.....	....	$10,000 annually to Smith Agr. School, 1906	.....	.....	.....	.....	Special buls. for teachers	Favorable	$5,000 appropriated for training teachers in agr. college, 1907	Industrial commission appointed, 1906

ATTITUDE OF STATES TOWARD AGRICULTURAL EDUCATION—*Continued*

State	Required by Law	When Passed	Agr. High Schools	Teachers' Examination	Text-book	Course of Study	Reading Circle	Special Aid	Recommendations	Addenda	Addenda
Michigan	.....	....	County, 1907; 1 organized	.....	.....	.....	.....	Sp. buls. for teachers Field work by Asst. supt.	Favorable	In 48 county normal schools agr. is required to be taught	.....
Minnesota	.....	....	County, 1905	.....	.....	7–8 grades	.....	Buls. for teachers	Favorable	State aid to 10 H. S. giving instruction in agr. $2,500 each	Special appropriation of $4,000 to promote agr. instruction in rural schools, 1901; county training schools give courses in agr.
Mississippi	Yes	....	County, 1908; $1,000 each	Yes	Yes	6 grade H. S.	.....	Organization of co. agr. H. S. Buls.	Favorable	.....	.....
Missouri	.....	....	.....	Yes; 1899	Yes	7–8 grades H. S.	.....	Sp. buls. Teachers' manual	State aid to H. S. teaching agr.	.....	.....
Montana	.....	....	.....	.....	Yes	5–8 grades	.....	.....	Favorable	.....	.....
Nebraska	.....	....	.....	Yes	Yes	8 grade H. S.	.....	Boys' clubs Field work by asst. supt. Teachers' manual	20 agr. H. S. recommended	.....	County normal schools and junior (summer) normal schools give courses in agr.
Nevada	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Hampshire	In approved H. S.	1906	.....	For H. S. certificate	.....	H. S.	.....	Teachers' manual	Favorable	.....	.....

New Jersey	.....	....	.....	.....	.....	Sch. gardens	.....	Summer school at Cape May, 1909	Favorable	Recommended by Industrial Commission of 1908	.....
New Mexico	.....	....	.....	.....	Yes	8 grade	.....	Teachers' manual	Favorable	.....	.....
New York	.....	....	3 special, 1908	Teachers in training schools	.....	8 grade H. S.	.....	Syllabus for elementary and H. S.	Favorable	Nixon law of 1897 provided for agr. extension including public schools	.....
North Carolina	Yes	1901	.....	Yes	Yes	7–8 grades H. S.	.....	Field work	Favorable	.....	.....
North Dakota	.....	....	1, 1905; to include forestry after 1907	.....	.....	7–8 grades H. S.	Yes, 1909	.....	Favorable	.....	.....
Ohio	.....	....	.....	.....	.....	7–8 grades	Yes	.....	Industrial Commission to be appointed by legislature of 1910	.....	.....
Oklahoma	Yes	1908	2 supreme court districts, 1908; county, 1901	Yes	Yes	7–8 grades H. S.	.....	Sp. buls. Teachers' manual	Appointment of supt. of public-school agriculture	.....	.....
Oregon	Yes	1905	.....	.....	Yes	7–8 grades H. S.	.....	Teachers' manual	Provision be made for deputy county supt. of public-school agr.	.....	.....
Pennsylvania	.....	....	.....	.....	.....	.....	.....	Agr. in 3 summer schools for teachers	Establishment of 300 tp. H. S. with agr. taught in each	.....	.....
Rhode Island	.....	....	.....	.....	.....	.....	.....	.....	Favorable	.....	.....
South Carolina	Yes	....	.....	.....	Yes	8 grade	.....	Educational campaign	Establishment of agr. H. S.	.....	.....

ATTITUDE OF STATES TOWARD AGRICULTURAL EDUCATION—*Continued*

State	Required by Law	When Passed	Agr. High School	Teachers' Examination	Text-Book	Course of Study	Reading Circle	Special Aid	Recommendations	Addenda	Addenda
South Dakota	.....	....	.....	.....	.....	8 grade H. S. elective	.....	Meetings with school officers	Favorable	.....	.....
Tennessee	In H. S.	1907	.....	.....	Yes	H. S.	.....	H. S. inspector	Favorable	.....	.....
Texas	Yes	1907	.....	Yes	Yes	8 grade H. S.	.....	Teachers' manual	Favorable	.....	.....
Utah	.....	....	.....	Yes Nature-study	.....	In grades as nature-study	.....	.....	Favorable	Last legislature passed resolutions favoring Burkett-Polland bill	.....
Vermont	.....	....	.....	.....	.....	Optional but recommended	.....	Buls.	Favorable	.....	.....
Virginia	.....	....	.....	Choice of one of physical geography, physics, or agr.	.....	.....	.....	Organization of 10 H. S. to teach agr.	Favorable	State aid of $2,000 each to 10 H. S. teaching agr.	
Washington	.....	.. ..	.....	Nature-study	Yes 1908	8 grade	Yes, 1907	.....	Favorable	.....	.....
West Virginia	Yes	1908	.....	Yes	.....	7-8 grades H. S.	Yes, 1908	Teachers' manual; special attention at teachers' institutes	Favorable	.....	.....
Wisconsin	Yes	1905	4 county, 1901; amended to increase to 8, 1908	Yes		7-8 grades H. S.	.....	Teachers' manual organization of county H. S.	Favorable	County training schools give instruction in agr.	
Wyoming	.....	....	.....	.....	.....	Optional	.....	.....	Favorable	.....	.....
Totals (48 states) ...	Yes 18, including optional and forestry No. 30		13 states 52 schools*	19 including nature-study	17	34 including optional	Yes, 8	33, probably others	46		

*Agricultural secondary schools connected with agricultural colleges are not included in tabulation; although receiving state aid they are under control of state agricultural colleges. The first was established in 1888 in Minnesota. Similar schools are now connected with agricultural colleges of over thirty states.

ondary schools is the attitude of the administrative officers of the various state departments of education. Special mention of the subject is made in nearly all of the latest annual or biennial reports from these offices. In some reports considerable space is given to discussions of industrial education with particular reference to agriculture.

Finally, if any interpretation is to be made of the attitude of state departments of education toward agricultural education it must be remembered that these offices represent the people, and that any policy or action taken is in a certain sense an expression of public opinion.

NOTE.—The writer wishes to express his appreciation of the cordial responses which he has received from his inquiries addressed to all the state and territorial departments of education.

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MEASUREMENT OF GROWTH AND EFFICIENCY IN ARITHMETIC (*Continued*)

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Taking up now the analysis of the tests, Table III gives the grade scores in the four operations. They have been recomputed from the actual results on a basis of uniform grade membership and equalized on the basis of equal thirteenth-grade attempts in each operation. The scores for fundamentals are by examples. The scores by points show no fundamental differences. The scores for subtraction, which occurs incidentally in division, have the same general relations as those for division and are not given. The scores in reasoning are by points. It is to be remembered, however, that a point in reasoning was one step of a problem, really a simple example by itself. The results are given graphically in Plots 6 and 7.

TABLE III

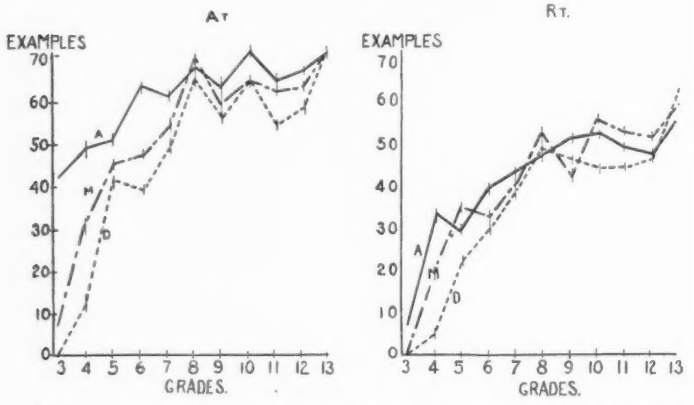
GRADE SCORES IN THE FOUR OPERATIONS

Recomputed on basis of uniform grade membership and equalized on basis of equal thirteenth-grade attempts in each operation.

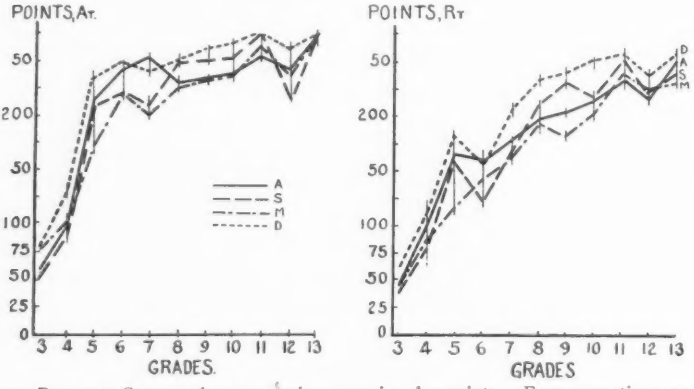
GRADE	FUNDAMENTALS BY EXAMPLES						REASONING BY POINTS							
	Attempts			Rights			Attempts				Rights			
	A	M	D	A	M	D	A	S	M	D	A	S	M	D
3	44	4	0	6	0	0	60	52	77	81	43	37	43	62
4	50	35	12	34	22	5	99	90	105	128	97	77	87	108
5	52	46	43	30	36	23	213	209	172	234	164	157	117	181
6	64	48	40	40	34	31	228	221	220	250	159	120	141	156
7	62	55	50	44	42	40	259	209	201	242	175	167	161	206
8	70	71	67	48	54	50	234	248	225	252	196	210	192	234
9	64	60	58	53	44	47	238	251	236	264	205	232	180	238
10	74	69	70	54	58	46	240	253	239	267	213	217	202	250
11	66	63	56	50	54	46	256	273	263	274	232	251	240	257
12	68	64	60	49	53	47	242	240	239	260	215	220	224	238
13	74	74	74	58	61	64	273	273	273	273	250	237	231	256

[1]For the first part of this paper see the *Elementary School Teacher* for October.

The curves show plainly the relative amount of development in each operation and the defects of the various grades. Thus, in Plot 6, fundamentals, in the fifth-grade drill has been



PLOT 6.—Comparative scores in fundamentals by examples. Addition, multiplication, and division as shown in Table III.



PLOT 7.—Comparative scores in reasoning by points. Four operations as shown in Table III.

given on the multiplication tables and long division, both learned in the grade before but mastered here, to the detriment of addition. Grade 9, on the other hand, is strong on addition and weak

on multiplication and division. The form of the curve for any one operation would be very interesting if these were the results of one class for 13 years. Note the form of the curves in the high-school years. Algebra seems to help addition and multiplication which do not begin to decline before eleventh grade geometry, but does not aid division which declines from the eighth grade. However, the variation from grade to grade, which was partially eliminated in the combined results, is very evident here and prevents any such conclusions. For instance, the failure of the tenth grade in division was probably due to a grade defect and not to the lack of practice in algebra, for the thirteenth grade did better in division than anything else. The curves for reasoning permit similar diagnoses of defects and the remedy in each case is evident. Whether such analysis is of value can be told only after a year's remedial work and another test. The most evident fact to be inferred from these curves is that of grade variation and peculiarity. Because a class does well in addition it will not necessarily do well in any other operation, not even subtraction. The cause of such variation and peculiarities must be a subject for psychological investigation before much scientific teaching can be done. The curves obtained seem to the writer further evidence of the rudimentary and chaotic state of our present knowledge.

These results also have some bearing on the much-discussed question of the transfer of mental training from one subject to another. If skill in addition does not influence skill in subtraction, it would seem that there could be little hope of transfer of skill to any other subject. That something is transferred, however, we all know: what it is, is another story. These results seem to uphold the contention of certain psychologists against the value of special training in the development of general ability.

The results have, also, a bearing on the question of the relative degree of difficulty in the four operations. If the examples right are expressed as percentages of those attempted, we have the data presented in Table IV. These same facts are summarized in Table V.

These results make it probable that accuracy of work is a function of the development of the child, and in a way independent of his arithmetical training. Each grade seems to have a

TABLE IV

EFFICIENCIES IN FOUR OPERATIONS IN FUNDAMENTALS AND REASONING

Examples right expressed as percentages of examples attempted

GRADE	FUNDAMENTALS			REASONING			
	A	M	D	A	S	M	D
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
3	14	0	0	72	71	57	77
4	68	63	42	98	86	82	85
5	60	78	54	77	75	68	77
6	63	71	78	70	55	64	62
7	71	76	80	68	79	80	85
8	69	76	75	83	85	85	93
9	83	73	81	86	93	76	90
10	73	84	66	89	86	87	94
11	76	86	82	91	92	91	93
12	72	83	73	89	92	75	92
13	78	83	87	93	87	85	93

TABLE V

RELATIVE DIFFICULTY OF FOUR OPERATIONS

Derived from Table IV

GRADE	FUNDAMENTALS											TOTALS			CONCLUSION
	3	4	5	6	7	8	9	10	11	12	13	A	M	D	
Easiest ..	A	A	M	D	D	M	A	M	M	M	D	3	5	3	M
Next		M	A	M	M	D	D	A	D	D	M	2	4	4	D, M
Hardest .		D	D	A	A	A	M	D	A	A	A	6	1	3	A

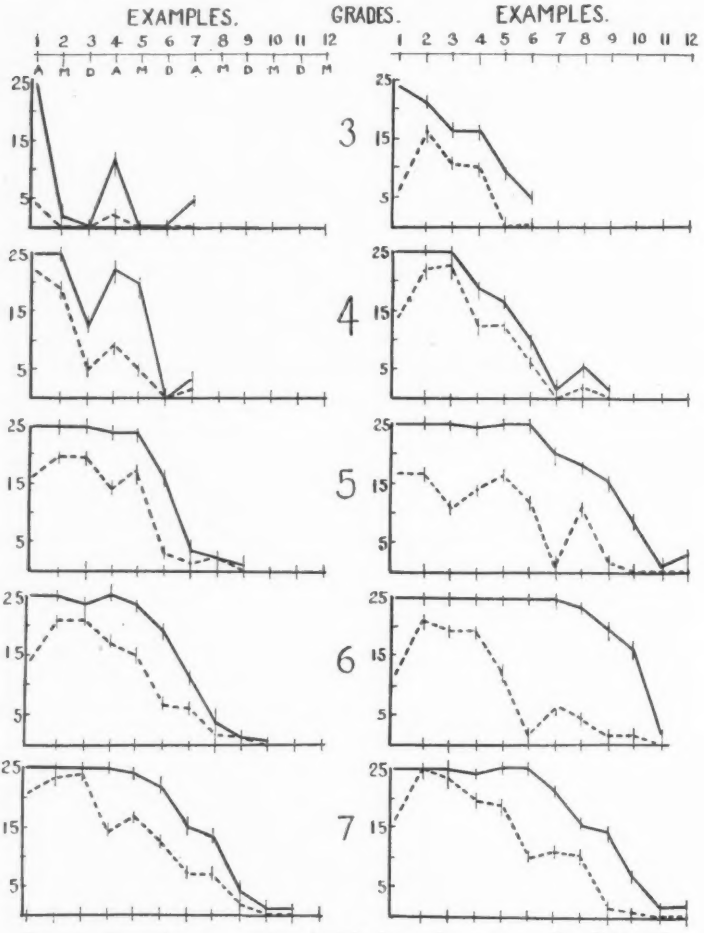
GRADE	REASONING											TOTALS				CONCLUSION
	3	4	5	6	7	8	9	10	11	12	13	A	S	M	D	
Easiest...	D	A	DA	A	D	D	S	D	D	DS	DA	4	2	0	8	D
Next.....	A	S	DA	M	M	MS	D	A	S	DS	DA	4	4	3	4	ASD
Next.....	S	D	S	D	S	MS	A	M	MA	A	S	3	5	3	2	S
Hardest. .	M	M	M	S	A	A	M	S	MA	M	M	2	2	7	0	M

certain general degree of accuracy, which after the early years of learning does not seem to increase as one would expect. Within the limits of the accuracy of a class, all combinations of accuracies in the different operations are found, but the extremes

for each grade differ by about the same amount. So far as there is any indication of difference in difficulty between the different operations, the results agree with the conclusions of Dr. Stone: For fundamentals, addition being hardest, multiplication or division least difficult; for reasoning, multiplication hardest and division least difficult. In fundamentals, the reason is not hard to find. Much more has been made of the multiplication tables than of the addition tables. Multiplication and division are more complicated processes than addition and harder to teach. It often happens that addition is much neglected after the class is once fairly at work on long division. It seems practically certain that in the present state of our arithmetic teaching each operation and each part or division of a topic is learned by the child as a separate unrelated activity. There is no co-ordination, no welding of separate parts into one science of number, no appreciation of the meaning and purpose of arithmetic as a whole. Accordingly the incidental emphasis of the teacher on one topic or another, due to the varying mentalities of the different classes of the same grade leaves a lasting bias toward skill in one operation or another. It only remains to point out how, in later grade, a high-school class in algebra say, a weakness in one operation masked by a fair general ability, operates to make the best efforts of the teacher of no avail. What is apparently merely a lack of attention or care to detail of the algebra, is really due to a deep-rooted defect of previous training in some important particular skill. Both class and teacher attack the problem of correction blindly and at a place that may need no correction at all. The real benefit comes incidentally and all psychological experiments prove that the overcoming of unconscious habits through incidental unconscious training is very difficult and tedious. The value of complete, all-around training in the early grades in determining general ability in the later grades is very great. And whether or not development is complete and many sided can be told only by such tests and analyses as these.

Leaving now the question of ability, the analysis of the mistakes made will be taken up. The reason why a given ability was not obtained is a question of even greater pedagogical im-

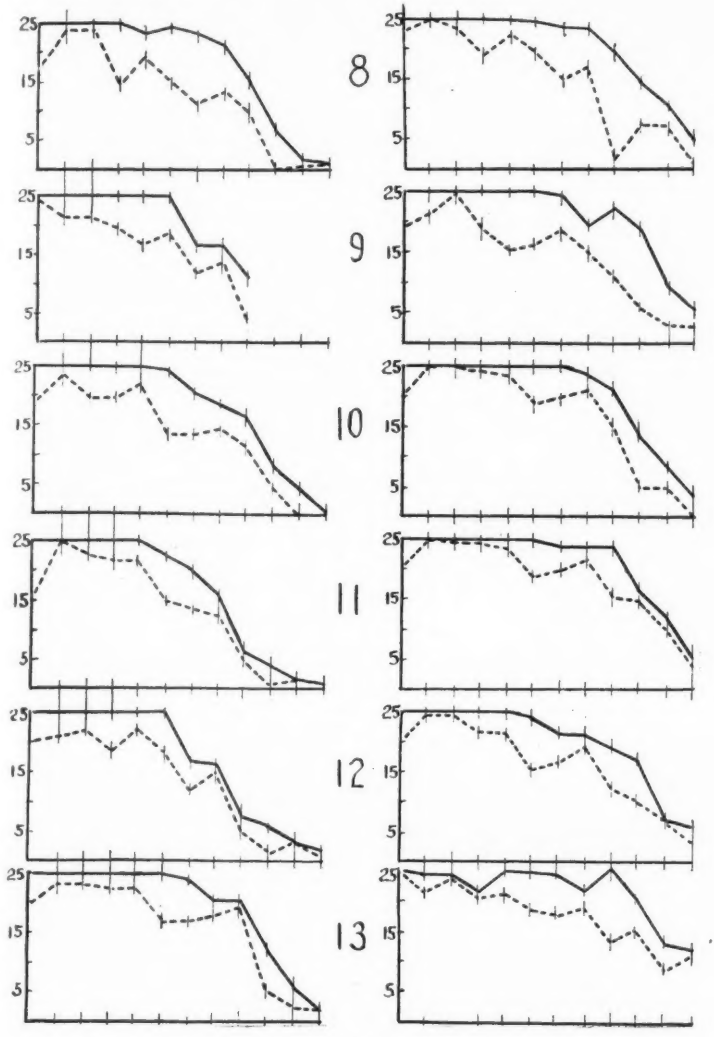
portance than that of what ability was attained. It is this question that the analysis should help answer.



PLOT 8.—Examples attempted and right in grades 3 to 7. See Table VI.

The first step is to gain a comprehensive view of the work actually done by each grade, and this is given in Table VI, plots 8 and 9, which show the examples attempted and right for each

grade in both tests. The results have been corrected to a uniform grade membership of 25.



PLOT 9.—Examples attempted and right in grades 8 to 13. See Table VI.

TABLE VI

GRADE RECORDS, ATTEMPTS AND RIGHTS, FOR EACH EXAMPLE IN BOTH TESTS

Results adjusted to uniform grade membership of 25

PART 1. FUNDAMENTALS

Examples

Grade	1		2		3		4		5		6		7		8		9		10		11		12	
	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.	At.	Rt.
3	25	4	2	0	0	0	12	2	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
4	25	22	25	19	12	5	22	9	20	5	0	0	3	2										
5	25	16	25	19	25	19	24	13	24	13	16	3	3	1	2	2	1	0						
6	25	14	25	21	23	21	25	17	23	14	19	7	12	6	4	2	2	2	2	0				
7	25	21	25	23	25	24	25	14	24	17	22	12	15	7	13	7	4	2	1	0	1	0		
8	25	18	25	24	25	24	25	14	23	19	24	14	23	11	21	13	15	10	7	0	2	1	1	1
9	25	24	25	22	25	22	25	19	25	17	24	18	17	11	17	13	10	4						
10	25	19	25	23	25	19	25	19	25	22	24	13	20	13	18	14	16	12	8	5	4	0	1	0
11	25	17	25	25	25	23	25	22	25	22	22	15	19	13	15	12	7	5	4	1	2	2	1	1
12	25	20	25	21	25	22	25	18	25	22	25	18	17	11	16	14	8	5	6	2	3	3	2	1
13	25	20	25	23	25	23	25	22	25	22	25	16	23	16	20	17	20	19	11	5	6	3	2	2

PART 2. REASONING

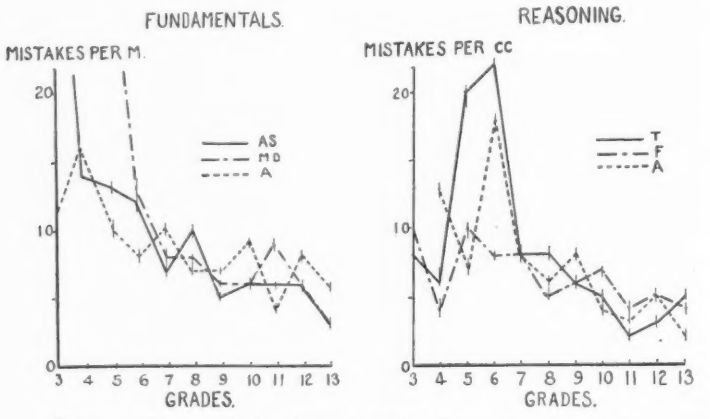
Examples

3	23	6	21	17	17	10	17	8	8	0	4	0												
4	25	14	25	22	25	23	18	12	16	12	8	5	2	0	5	2	2	0						
5	25	17	25	17	25	22	24	13	25	15	25	11	19	1	17	10	15	2	8	0	1	0	3	0
6	25	12	25	21	25	19	25	19	25	12	25	2	25	6	23	4	19	2	15	2	2	0		
7	25	17	25	25	25	23	24	19	25	18	25	10	21	11	15	10	14	2	8	1	2	0	2	0
8	25	23	25	25	25	23	25	18	25	22	24	18	23	14	23	17	19	2	14	7	11	7	5	1
9	25	19	25	22	25	25	25	18	25	15	25	16	24	18	19	15	22	11	18	6	8	3	6	3
10	25	17	25	25	25	25	25	24	25	24	25	16	25	19	23	17	21	14	16	5	8	5	5	0
11	25	21	25	25	25	24	25	24	25	23	25	18	23	19	23	21	23	15	17	14	13	10	6	4
12	25	21	25	25	25	24	25	22	25	22	24	15	22	17	22	19	19	12	17	10	6	3	5	3
13	25	24	24	22	24	24	22	20	25	21	25	18	24	17	22	18	25	13	20	15	13	8	12	11

The most striking fact shown by these results is again grade variation. The different forms of the fronts of the curves, from the convex forms of grades 6 and 7 to the concave variety shown in grade 12, fundamentals, signify different distributions of ability in the grades as will be shown later. Another striking fact is that for so few examples is the efficiency 100 per cent. Except where the example has been tried by but one or two, there is but one place in fundamentals (11th grade, 2d example) where all who tried a problem succeeded in getting it right. In reasoning the results are a little better, there being four cases of perfect scores for example 2 and two cases for example 3. These and the general forms of the curves make it apparent at once that the different examples varied greatly in their difficulty. For instance, in fundamentals, the curves for rights show a marked depression in many grades for examples 1, 4, and 7. But these are the addition examples and this fact but emphasizes the conclusion, reached before from a consideration of the scores for the various operations, that addition is the hardest operation. The excellence of grade 9 in addition could have been inferred from the fact that its curve shows no such depressions. So for other examples and grades.

The total mistakes made are given in Table VII. For comparison these are reduced to mistakes per thousand points. The results, however, give but another view of the growth in accuracy, previously shown in Plot 5; accordingly they are not plotted. Table VII also gives the analysis of mistakes. In fundamentals, addition and subtraction are grouped together (A and S), multiplication and division (M and D), and mistakes in copying or in carrying whether they occurred in one operation or another. These are called mistakes in attention (A). The purpose of this separation was to determine whether failure was due to a lack of knowledge of the addition and multiplication tables, or to a lack of ability to handle such knowledge in an example. The results have been reduced to those for uniform grade membership, and expressed as mistakes per thousand points for purposes of comparison. (Mistakes per two hundred points in reasoning.) It seemed better, also, to use individuals making mistakes

rather than mistakes themselves, as a single individual, weak in her knowledge of the multiplication tables, was found to contribute many mistakes in multiplication in a single example. The scores have been called "mistakes" to save time and space, and have been much more accurately determined for fundamentals than for reasoning. In reasoning, as previously explained, mistakes were analyzed into mistakes of understanding (T), mistakes of fundamentals (F), and mistakes of attention (A).



PLOT 10.—Shows mistakes in each grade. For explanation of letters see foregoing text.

In both tests the total score in points is made the basis of the computations of mistakes per thousand in attention. While this is fair from one point of view, it masks the relative size of the different groups. Accordingly, the results have also been expressed in percentage of the total mistakes made for each grade. Plot 11 shows the same results graphically.

The most evident fact to be inferred from Plot 10 is the one noted previously, that after grade 7 the range of variation is fairly constant, and that within this range, the particular type of mistake made is a matter of grade peculiarity. The high values in the early grades are due, of course, to the fact that the learning process for the four operations has not been completed,

TABLE VII

Fundamentals

Grade							Per M			Percentage of TM		
	TM	MM	IM	AS	MD	A	AS	MD	A	AS	MD	A
3	81	89	43	33	0	10	36	0	11	78	0	21
4	76	48	58	16	17	25	14	50	16	28	39	43
5	97	36	73	22	26	25	13	34	10	30	36	34
6	98	32	61	25	12	24	12	13	8	41	20	39
7	69	21	55	15	8	32	7	8	10	27	15	58
8	85	20	70	28	11	31	10	8	7	40	16	44
9	53	15	43	10	7	26	4	6	7	23	16	61
10	68	15	65	17	8	40	6	6	9	26	12	62
11	49	14	42	15	10	17	6	9	4	36	24	40
12	66	17	53	15	7	31	6	6	8	28	13	59
13	57	12	45	12	4	31	3	3	6	27	5	69

Reasoning

Grade						Per CC			Percentage of TM		
	TM	MM	MT	MF	MA	T	F	A	T	F	A
3	51	255	8	10	33	8	10	33	15	20	65
4	37	118	9	6	22	6	4	13	24	16	60
5	109	177	59	29	21	20	10	7	54	27	19
6	160	201	73	25	62	22	8	18	45	16	39
7	75	118	24	26	25	8	8	8	32	35	33
8	69	100	29	18	22	8	5	6	42	26	32
9	72	100	24	21	27	6	6	8	33	29	38
10	57	80	18	24	15	5	7	4	32	42	26
11	38	49	9	16	13	2	4	3	24	42	34
12	48	67	12	18	18	3	5	5	24	38	38
13	50	64	20	17	13	5	4	3	40	34	26

KEY

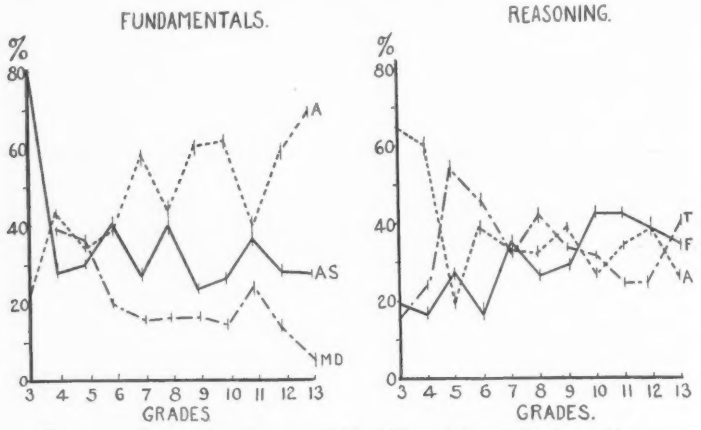
TM = Total Mistakes. MM = Mistakes per 1000. IM = Individuals making mistakes. AS = Individuals making mistakes in addition and subtraction. MD = Same, multiplication and division. A = Same, Attention. MT = Mistakes in understanding. MF = Mistakes in fundamentals.

SUPPLEMENT DATA

Grade	Total Points		Points A and S	Points M and D
	F	R		
3	917	202	906	0
4	1567	317	1327	340
5	2583	613	1773	809
6	3059	672	2136	923
7	3338	633	2317	1018
8	4324	690	2949	1376
9	3566	720	2455	1112
10	4426	720	3009	1416
11	3602	768	2510	1093
12	3903	712	2703	1200
13	4820	791	3263	1556

and the curves show plainly just where the learning of the different tables is done. In fundamentals, there is again not the evidence of growth that might be expected.

Plot 11 is more significant, as it indicates at once just where remedial work is to be done. In reading this plot however, care must be taken to consult the table, or Plot 10, to determine the



PLOT 11.—For explanation see Table VII and key following table.

actual amount of the mistakes in each group, in order not to be misled by the changes in the relative size of each group. Plot 11 shows that in fundamentals at grade 5 the size of the three groups is the same. That is, the child can direct her attention to her work just about as successfully as she can call upon a knowledge of the various tables needed in this test. Absolutely, the knowledge lags behind the attention as shown in Plot 10; for the test does not make equal demands upon all the operations. From grade 5 on, multiplication receives its proper training, so the curve declines until the mistakes in multiplication become a very small part of the whole. Addition improves so slowly that the percentage the addition mistakes are of the whole remains fairly constant. The child, however, receives, it would seem, no training in the use of her knowledge, and knows how to direct her attention no better at the higher grades than at grade 5. Conse-

quently the relative percentage of the mistakes rises higher and higher. Even absolutely, in mistakes per thousand, the mistakes in attention outnumber the rest in five of the grades from the 7th to the 13th.

In reasoning the subject-matter is different and no direct comparison of the results can be made. It is interesting to note, however, that both in mistakes per cc and in percentages, in five of the grades mistakes in attention or mistakes in fundamentals which is due to the same cause are greater than mistakes in understanding.

This point, it seems to the writer, is an important one. Whatever the explanation, there can be no question of the fact that of all the individuals making mistakes at any given time in a class, at least one-third, and usually two-thirds, will be making mistakes in carrying or copying. The writer well knows that in discovering these mistakes there was much room for error. Yet it is to be remembered that the fact itself was made so evident in the general scoring that a second examination was made for the special purpose of separating these mistakes from the others. Also, the same method was used throughout, and should operate no more unjustly in one grade than in another. It is possible, and may be worth while, to carry the analysis farther.

The last subject to be considered in connection with the test, and to the writer the most important subject, is that of the distribution of ability in the grades. The total scores cover up many important facts and it is important, if any use is to be made of the results in determining future growth, that the present condition of each grade be exactly known.

The twelfth and largest grade has been selected for a detailed study. In Table VIII and Graph 12 are given the individual scores of the 33 members of this grade grouped in various ways. At the top of Plot 12, the individual scores are represented by straight lines drawn to scale. It is evident at once that the extreme variation found in the different grades is also found in the individuals composing the grades. Some degree of variation was to be expected; the question is, how much is normal. The lowest score given is 71; the highest 274: yet both were "passed"

through eight years of arithmetic training, to say nothing of the training of the high-school years in mathematics and science. Now a "pass" is supposed to stand for an efficiency of 70 per

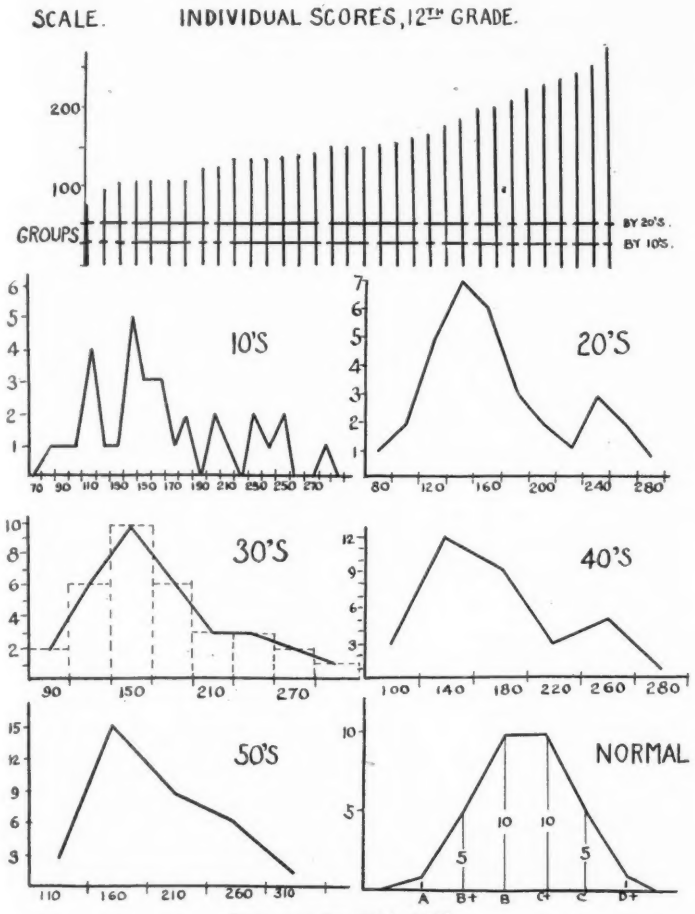
TABLE VIII

INDIVIDUAL SCORES AND GROUPINGS, GRADE 12. POINTS ATTEMPTED

INDIVIDUAL SCORES	BY 10'S		BY 20'S		BY 30'S		BY 40'S		BY 50'S	
	Score	Frequency	Score	Frequency	Score	Frequency	Score	Frequency	Score	Frequency
71.....	71– 80	1	61– 80	1	61– 90	2	61–100	3	50–100	3
88.....	81– 90	0	100	2	120	6	140	12	150	15
96.....	91–100	1	120	5	150	10	180	9	200	8
103.....	101–110	4	140	7	180	6	220	3	250	6
103.....	111–120	1	160	6	200	3	260	5	300	1
103.....	121–130	1	180	3	240	3	300	1		
103.....	131–140	6	200	2	270	2				
118.....	141–150	3	220	1	300	1				
122.....	151–160	3	240	3						
131.....	161–170	1	260	2						
131.....	171–180	2	280	1						
131.....	181–190	0								
135.....	191–200	2								
136.....	201–210	1								
139.....	211–220	0								
145.....	221–230	2								
145.....	231–240	1								
145.....	241–250	2								
151.....	251–260	0								
153.....	261–270	0								
158.....	271–280	1								
161.....										
171.....										
180.....										
194.....										
199.....										
204.....										
221.....										
223.....										
234.....										
241.....										
250.....										
274.....										

cent. at the very lowest, and the mark aimed at is 85–90 per cent. Either the system of marking and examining is very defective or there has been marked deterioration during high-school years in a large part of the class. Perhaps this variation can be made most plain by computing from the normal curve in Plot 4 the average value of the individual score in each grade

and expressing the composition of grade 12 in terms of members of the other grades. If this is done it will be found that the



PLOT 12.—See Table VIII.

scores show grade 12 to be composed of 1 member of third-grade ability, 7 members of fourth-grade ability, 12 members of fifth-grade ability, 3 of sixth, 1 each of seventh-, twelfth-, and thir-

teenth grade abilities, and 7 members whose individual scores are above the average of the thirteenth grade. Over half the class is thus seen to be of less ability than the average ability of the sixth-grade class. This is evidently a subject that needs to be followed through with every grade. The method of doing this is that usually followed in discussions of distribution. The different individual scores are grouped together and the frequency with which any one score occurs can then be expressed by a single number. It is evident that if single scores are used the frequencies will be small, and the number of groups large. By dividing the whole score into equal parts, the number of groups can be decreased and the frequencies increased. The size of the measure to be used in any discussion depends upon the number of individual scores to be studied as well as upon the range of the variation. The highest score made by any individual in fundamentals was 278 points, the lowest 0. There are 11 grades. To allow for some overlapping, it seemed advisable to have more divisions of the score than there were grades, and yet a coarse measure was needed on account of the great variation. On the representation of the individual scores on Plot 12, the heavy black cross lines show the grouping when the total score is divided into periods of 10 points each, and into 20's. These groupings furnish the data for the distribution curves by 10's and 20's given immediately underneath. The divisions of the score are shown along the base line. One hundred and ten in the first graph meaning a group of all the scores from 101–110 inclusive. An inspection of the cross lines or of the table, will show four scores that fall within these limits. Accordingly the curve at this point rises to 4 above the base line. The size of the measure is thus shown along the base line and the frequency of any particular measure by heights above it.

An inspection of the distribution curve by 10's shows a succession of peaks, partially or wholly disconnected, while the same curve by 20's is a continuous curve. The normal distribution curve for any quality or ability in a large number of individuals has been determined, and for a group of 32 normal individuals would take the form shown at the bottom of Plot 12,

marked normal. This means that in a class of 32 normal individuals, properly graded, there would be two groups of 10 each, to which the marks B and C+ could be given. On each side of these would be a smaller group of 5 each; one better, B+; one worse, C. Beyond these are two still smaller groups of one each, one of exceptional ability, A, the other very poor, D+. The real ability of the group ought to be taken as that of its central tendency, the central scores about which all the rest cluster, in this case the average of B and C+. In the

TABLE IX

DISTRIBUTION OF ABILITY

Based on individual scores in points. Each grade raised to fifty members

PART I. FUNDAMENTALS

GRADE	SCORES AND FREQUENCIES													
	0-20	21-40	60	80	100	120	140	160	180	200	220	240	260	280
3 At.	13	29	8											
Rt.	36	20												
4 At.		3	16	25	0	3	0	0	3					
Rt.		9	25	12	3									
5 At.			2	5	28	7	2	5	0	2				
Rt.			2	11	25	5	5	2	2					
6 At.				12	3	11	12	7	0	0	0	3		
Rt.			7	8	0	16	8	7	0	0	3			
7 At.				5	2	14	5	16	7	0	0	2		
Rt.				7	5	11	9	16	0	0	0	2		
8 At.						5	7	5	19	2	7	2	2	
Rt.					2	5	7	7	14	1	7	2	2	
9 At.					3	14	3	14	8	3	6			
Rt.					3	17	3	14	6	6	3			
10 At.					2	4	10	4	8	2	4	12	3	
Rt.					4	4	10	8	2	2	8	10	0	
11 At.				6	0	11	2	17	4	0	4	0	4	
Rt.				6	6	8	6	11	2	0	4	0	4	
12 At.				1	3	7	11	9	4	3	1	4	3	1
Rt.				3	6	6	9	12	3	4	4	0	0	1
13 At.						3	3	0	16	9	6	6	3	3
Rt.						3	3	6	13	6	6	3	3	

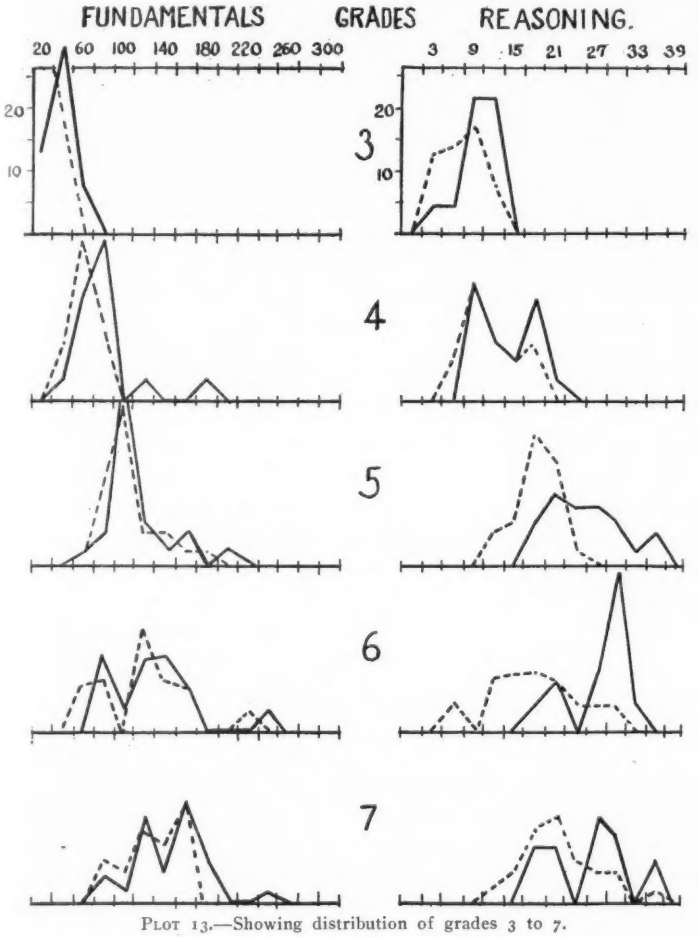
PART 2. REASONING

GRADE	SCORES AND FREQUENCIES											
	0–3	3–6	9	12	15	18	21	24	27	30	33	36
3 At.	4	4	21	21								
Rt.	12	13	17	8								
4 At.			19	9	6	16	3					
Rt.		6	19	9	6	9						
5 At.						7	11	9	9	7	2	5
Rt.				5	7	21	16	2				
6 At.						4	8	0	9	25	4	
Rt.		4	0	8	9	9	8	4				
7 At.						9	9	0	11	11	0	7
Rt.				2	5	12	14	7	5	5	0	2
8 At.					2	5	7	2	5	7	12	10
Rt.				2	2	5	10	7	10	2	7	5
9 At.							3	5	13	5	19	3
Rt.						5	13	5	8	16	3	
10 At.							11	0	9	14	9	7
Rt.							13	5	13	16	0	2
11 At.							2	2	10	10	14	12
Rt.							4	8	12	6	12	8
12 At.				2	0	2	5	3	2	18	2	12
Rt.			2	2	0	2	10	2	14	10	3	3
13 At.								7	3	13	8	18
Rt.						5	5	10	3	8	8	13

case of grade 12 above, it can be seen at once from the curve by 20's that the central tendency is from 120 to 140. Other curves are given to show the effect of coarser measures. In the case of the curve by 30's, representation by rectangles is also given as this method of drawing the distribution curve is sometimes used to indicate also the size of the measure. In all these curves, however, it will be noted that the individual abilities of grade 12 are in the main grouped about a low score but that there is in addition a smaller group of much greater ability.

For the general study of the distribution of ability in the grades, the measure is taken as 20 points for fundamentals and 3 points for reasoning. This gives 16 groups for fundamentals

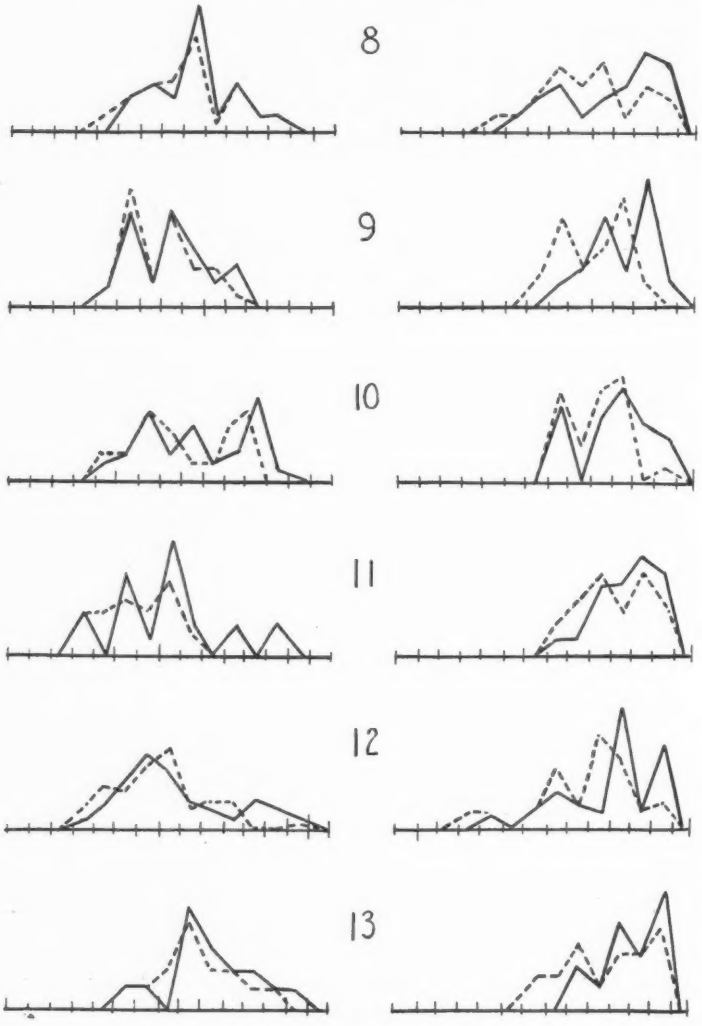
and 12 for reasoning. Each grade is raised to 50 members for convenience in plotting and all are plotted on the same scale.



PLOT 13.—Showing distribution of grades 3 to 7.

The full line represents attempts and the dotted line rights in every case. The curves for fundamentals and reasoning are given side by side in order that the distribution of the same grade

in the two tests may be compared. The graphs will be known as Plots 13 and 14 and the data for it is given in Table IX.



PLOT 14.—Showing distribution of grades 8 to 13.

A very hasty glance at Plot 14 reveals a very irregular distribution of ability in all grades after the fifth, and it seems more than likely that the extent of the variation is much greater than would be normal under any kind of scientific study of individual abilities and needs. It seems to the writer that the determination of the causes of the wide variation in individuals, and the marking out of certain broad classification of individuals according to their peculiar abilities together with the determination of special training adapted for each class is the immediate problem of psychology upon whose solution any beginning of a scientific pedagogy must depend. For it is evident from the Plot that in the early grades the classes are units, but that as the pupils pass from grade to grade, individuals react to the training in different ways, so that the unity of the grade is broken up. It has long been evident that individuals in a class learn enough to pass examinations in very different ways. Some learn understandingly; some mechanically; that is, so that they can do the work set by a particular teacher in a certain way or place, but not so they can use the knowledge gained in any other place or for any other teacher. Whatever the explanation, a poor class, as grade 6, is here found to have a distribution showing several groups of very different abilities, while a good class, as grade 11, reasoning, is here shown to approach the normal distribution. This corresponds with teaching experience. Any teacher working with a small enough class to know the individuals, is conscious of the spur of a compact group of evenly graded children and the drag of the struggle with groups of individuals requiring special handling.

A careful study of the curves for fundamentals will show that the central tendency of the eighth grade is equaled by a large group in no grade except the thirteenth. A small group in the tenth grade is the only exception of any size. This seems to mean that the whole eighth grade has reached as high a degree of ability at the eighth grade as that attained by the high-school grades. The extent of the distribution in this class is greater than would seem right but otherwise it will make a good grade from which to determine what happens to ability in arithmetic during the high-school years.

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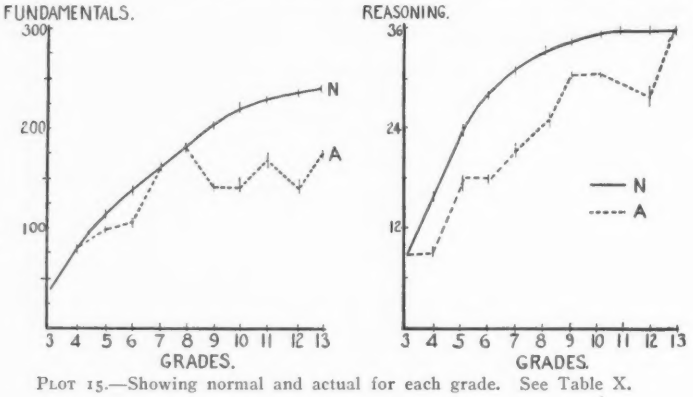
The curves of Plot 15 permit a score being selected as the typical individual score for a grade; also, another score as the probable individual score that might be reached by the average



PLOT 15.—Showing normal and actual for each grade. See Table X.

of the class if all received the same benefit from their training as the best group. These values are given in Table X and their graph, 15, gives another possible normal and the departure of

TABLE X

NORMAL AND ACTUAL INDIVIDUAL SCORES DERIVED FROM PLOT 15

	GRADES										
	3	4	5	6	7	8	9	10	11	12	13
Attempts—											
Fundamentals, normal....	40	80	...	...	160	180	...	220	...	...	240
Fundamentals, central tendency.....	40	80	100	110	160	180	140	140	160	140	180
Rights—											
Reasoning, normal.....	9	15	24	...	...	33	...	...	...	...	36
Reasoning, central tendency	9	9	18	18	21	24	30	30	30	27	36

the present state of the school from it. It will be noted that the values in these curves are higher than those in the normals previously established and in most cases, the actual condition somewhat lower. These normals, the one of grade ability and the other of individual ability, furnish standards that make it worth while to attempt special remedial work with both individuals and grades. Their actual value can only be told by use.

From the foregoing tables and plots, it will be seen that this test, while originally purely accidental and experimental in character, and not designed for the close analysis to which it has been subjected, has, nevertheless, yielded many results of value to the writer in his work of supervision. It has shown the need for greater knowledge of what is actually taking place in the child's mind as he passes through grade after grade. It has made plain the uncertainty of the product of the present educational system as well as the value of complete and many-sided training in the early grades if there is to be great ability in the later grades. More than all else it has proved, conclusively to the writer at least, that it is practicable to measure, not only the general condition of arithmetic teaching throughout a school, the growth in ability and efficiency from grade to grade, the defects and needs of any one grade or individual, but the *effects of changes in method or procedure* as well. By a series of tests, through a number of years, it ought to be possible to build up a real science of teaching and to determine by strict experimental methods the truth or falsity of any educational hypothesis. Nor is the method applicable to mathematics alone. In any subject taught in many successive grades, similar comparative testing will not only tend to produce increased efficiency but it will, judging by the results of the present test, furnish a connective thread of growth in the fundamentals of the subject that will produce a unity that is sadly lacking in all present pedagogical effort.

EDITORIAL NOTES

General Reasons for the Decline of Drill

There are many reasons why mere repetition of lessons is no longer practiced in schools. In the first place, there is so much good material to be presented that the teacher feels that the child will not come into contact with the world which science and industry have opened up unless new facts are crowded into every lesson. In the second place it is very difficult to whip up attention and keep alive interest when the subject-matter is familiar and partially mastered. In the third place, it is easy to devise tests which shall show the breadth of a pupil's knowledge and it is difficult to measure the depth and permanency of an impression on the mind. The school which gives the least breadth of training is consequently at a seeming disadvantage even if the depth of its training is greater.

Modern Pedagogical Justifications for Omission of Drill

There are other reasons of the same general type which have contributed to the result that drill has come to be almost a lost art in the modern school. One hears various devices described by which children are to be drilled without being allowed to become aware of what is going on. The same material, we are told, can be presented in various forms; the same principle can be exhibited in various settings; and the ends thus attained which were sought in the old-fashioned drill. Again we find some writers explicitly saying that the mind does not get general training except by sweeping over the whole world. The improvement of experience comes therefore through manifold activities of diverse types, there is no such thing as drilling a few fundamental faculties. The drill of the old school was aiming at a false goal.

School Work in Need of Sifting

It would be futile to criticize this tendency to omit or evade drill if one were armed only with prejudices in favor of the old-fashioned school. Modern reasons must be matched to modern reasons. Let us see if some reasons cannot be briefly presented in favor of drill. First, children in our present-day schools are confused

by the mass of material presented to them. They are rushed recklessly from fact to fact and left with fagged minds to wallow in the unorganized mass of new impressions. Many teachers could not organize the material which they give the children so that it would form a coherent, presentable paper for rehearsal before other teachers. How can children organize this material? We shall settle down some day to a few well-selected, well-arranged materials of instruction. We are suffering today from pedagogical surfeit and the absence of drill in our schools is one of the symptoms of this condition.

Repetition Essential to Mental Development

If our studies of brain physiology and functional psychology show one result more clearly than another it is that repetition is absolutely essential to mental development. Mutual development depends upon the organization of the nervous functions in such a way that impulses shall follow fixed paths of discharge. New impulses call for new organizations. One cannot reorganize at ever step, one must establish and fix before he can advance to higher organizations. The question of how education is to organize the individual—whether in higher or lower types of thought and behavior—depends for its answer very largely upon the time given to permanent organization as distinguished from mere temporary organization. The results which have been offered by scientific students in opposition to the doctrine of general mental discipline are often more valuable as criticisms of our present-day methods than as criticisms of the doctrine of discipline. There is many a course in geography which gives no general mental discipline. That does not prove that geography might not give mental discipline of a general type. The question which we ought to be discussing is not whether there is such a training as will discipline the general faculties, but rather how the most permanent effects may be produced through the training which we give.

"Drill" should be reintroduced into our pedagogical vocabularies. It represents a phase of method which is indispensable and clearly justifiable.

NOTES AND NEWS

NEED OF DIFFERENT ELEMENTARY SCHOOL COURSES

That the elementary school may in reality afford equality of educational opportunity, that it may take into account the differences in the social body and the differences in children, it is necessary that a distinction be made between the work of giving children the rudiments of an education and preparing them for a higher academic institution, and the work of giving children the fundamentals of an education and fitting them for early entrance upon life-pursuit, and there is need that separate courses of instruction be provided for the accomplishment of these different purposes.

There are at least three ways of doing this dual work of the elementary school. First an option may be offered in all grades between two courses, one designed for children who purpose to continue their schooling, the other adapted to the interests and needs of children who from choice or necessity expect to complete their education with the grades. A second means is to provide one course of study in the first four grades for all children, and to offer an option in the four grammar grades between two courses, the one designed for those going on, and the other for those expecting to attend no other school. A third means, supplementary to the second, is to organize elementary industrial schools as separate centers of instruction and provide a course of study half of which is devoted to the more practical portions of the fundamental academic branches and the other half to industrial studies and activities.

The second of these suggestions is to be tried in Cleveland this year. Two courses are to be prepared for the four grammar grades—the one adapted to the needs of children of literary taste and going on to the high school, the other to the needs of children looking to early entrance upon life-pursuit. This second course is to be rendered flexible so as to meet the needs of different districts and groups of children through permitting of a maximum and minimum of time that may be given to the several studies, and may be installed at the option of the principal with the consent of the superintendent, but the selection of this course to be optional with the parent.

The third suggestion is to be embodied in an elementary industrial school for boys and girls who are more than thirteen years of age and not below the sixth grade. The course will be two years in length, consisting of two types of work, academic and industrial, and the time of the school will be equally divided between the two. This school will interest boys and girls to whom the regular course is unduly literary and who are not interested in bookish things, and it will also interest those whose economic condition requires them to leave school early to become wage-earners.

The academic studies comprise: English, arithmetic, and geography-history. The English will consist of spelling, writing, reading, literature, and composition. The arithmetic will include accounts and shop problems. The geography-history will deal with the industrial, commercial, and political phases of our national development as well as municipal studies.

On the industrial side the course will include, for boys, benchwork in wood and sheet metal, freehand drawing and design, and mechanical drawing; for girls, sewing and garment-making, cooking and household arts, freehand drawing, design, and construction. Throughout the work will be made intensely practical and be given a direct industrial and commercial turn.

These optional courses designed to meet the needs of children who will probably attend no other schools should, however, by no means lead educationally into a blind alley. They should give such place to the essentials of the three R's and so emphasize neatness, thoroughness, and accuracy in industrial and commercial work, that the child completing such a course would be admitted to manual training or technical high schools and be able, by doing a certain amount of literary work in addition, to gain entrance to an academic high school.

WILLIAM H. ELSON
Superintendent of Cleveland Schools
FRANK P. BACHMAN
Assistant Superintendent

School Gardening and Nature Study in English Rural Schools and in London is the title of Bulletin No. 204 of the Office of Experiment Stations, of the U. S. Department of Agriculture. The Bulletin is written by Miss Susan B. Sipe who has previously rendered similar valuable assistance in the publication of other articles upon school gardening. This bulletin deals with nature-study in the schools of Whitechapel, London, at the Kentish Town Road School, London, with rural school gardens, and with teacher's courses and examinations.

This entire description of what is being done in English schools in natural-history work is filled with the idea of dynamic as compared with what may be called static natural history. Live plants and animals, outdoor studies in great number, the growth of plants in school gardens, the growth of animals in the school garden and about the home are matters of constant mention. The fact that growing plants and animals have large educative results with children seems to be a central factor in the work in English schools, if Miss Sipe's description is representative of conditions in general. The bulletin will be found valuable for all who are interested in supervising or teaching the different aspects of natural history.

O. W. CALDWELL

BOOK REVIEWS

Moral Principles in Education. By JOHN DEWEY. "Riverside Educational Monographs." Houghton, Mifflin & Co., 1909. Pp. 61. Price 35 cents, net, postpaid.

This book gives us a new edition of the most important work we have upon the subject of moral education. It is the address given before the National Herbart Society (now the National Society for the Scientific Study of Education) at the Milwaukee meeting in 1897. It is easily the most significant contribution that society has made. There has not been much change in the thought, but considerable improvement in form. The editor's introduction deals with education as a public business and as expert service, and the relations of expert opinion and public opinion, stating clearly a range of problems upon which our administrators may well spend more thought.

The tendency toward extensive analysis of the text, seen in all the numbers of this series (perhaps overdone in some cases) here gives the material in better form for use. The old first section is broken up into (i) The Moral Purpose of the School; (ii) The Moral Training Given by the School Community; (iii) The Moral Training from Methods of Instruction; (iv) The Social Nature of the Course of Study. The original second section becomes (v) The Psychological Aspect of Moral Education. This last section seems to be the least changed in statement. The most striking change is the systematic use of the word "moral" rather than "ethical." The title is now "Moral Principles" rather than "Ethical Principles" and this is followed up throughout the text by a general substitution of the former term for the latter.

It is to be hoped that we shall soon have Dr. Dewey's address at the St. Augustine meeting, 1896, on "Interest as Related to Will" in equally good form. Dr. De Garmo's popularization of it in *Interest in Education* is helpful but does not do away with the need of the original text. FRANK A. MANNY

KALAMAZOO, MICH.

Teaching Children to Study. By LIDA B. EARHART, PH.D. "Riverside Educational Monographs." Houghton, Mifflin Co. Pp. 182. Price 35 cents.

This is a subject we need help upon and every contribution will be of service. Dr. Earhart's thesis, *Systematic Study in the Elementary Schools,* which appeared last year has been rewritten and the tables and other more formal elements have been omitted. The material here consists of a general statement of logical study followed by its application to the work of pupils in the intermediate and grammar grades. The theoretical statement is given first, probably with the intention of formulating the problem, but the result is not altogether fortunate for the exposition afforded is somewhat formal for the students who have not some considerable acquaintance with genetic logic and is scarcely adequate for those who have. Mrs. Young's chapter on this material in *Isolation in the School,* presents the problem rather more effectively and economically. The later sections on "Do Children Possess the Ability to Study Logically?" etc., are more suggestive but not convincing with reference to the aid that here will be gained.

The method used in securing the data is not given concretely. As the author says, "It is difficult to write suggestions, because as soon as written they appear very rigid and lacking in adaptability." The general summary gives ten statements which illustrate this difficulty and also confirm the suspicion one has in reading the preface that recent workers on this topic have overrated, by no means our need, but at least the recentness of the discovery and the value of the development. The "entirely new light" (p. viii) which the editor of the series values for its "newness" (p. xi) and its contribution which is "more than any other document now in print" (p. xii), does not seem to be as novel or as luminous as we had hoped. We are grateful to the author for co-ordinating material on the subject and look forward to Dr. Frank McMurry's *How to Study and Teaching How to Study* for additional material.

One serious defect in the present book arises from the incidental method in which the thinking of children of primary grades is referred to. It may be too strong to say that it seems as if, according to the author, the earlier years could be left to the older more formal ways, but there certainly is not much reference to the basal work done in the recognition of the type of logical thinking appropriate to this stage as illustrated in the reports of Dr. Dewey's work at Chicago.

To many of us the present movement would be made more serviceable if it were less segregated. For some time we have recognized two planes of evolution—one that of brute experience, growth, and development by hard knocks through which one learned at great risk and expense, and a second in which consciousness is able to project a problem and then to try this out by means of the expenditure of a much more limited amount of energy and material. This latter is seen in the best laboratory work. This new light on study seems to have an important connection with this larger movement and would gain, I believe, by relation to it rather than by separation.

FRANK A. MANNY

KALAMAZOO, MICH.

Ethical and Moral Instruction in Schools. By GEORGE HERBERT PALMER; *Self-Cultivation in English.* By GEORGE HERBERT PALMER. "Riverside Educational Monographs." Houghton, Mifflin & Co. Each 35 cents, net, postpaid.

These three essays have been of great service to many parents and teachers. The second volume *Self-Cultivation in English* has been more accessible than the others and from the nature of its subject has had more direct influence in schools. The mature thought of a man of knowledge and power in the two great fields of philosophy and literature cannot but be of value when formulated about these practical subjects. Professor Palmer lays great stress upon habit-formation and his discussion is a needed corrective of the tendency to overstress direct and formal ethical instruction. He does not, however, seem to make clear that just as in every act of perception there is involved a judgment; so the life of the child before adolescence, while clearly having its major activity on the plane of memory and habit, requires very careful and adequate attention to its real needs in higher psychical functions as judgment and reasoning. One can account a function as minor for a time without agreeing to its neglect. The idealistic dualism that brings judgment in as practically a new element at adolescence is too easy a way out.

FRANK A. MANNY

KALAMAZOO, MICH.

CURRENT EDUCATIONAL LITERATURE IN THE PERIODICALS[1]

IRENE WARREN
Librarian, School of Education, The University of Chicago

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BANCROFT, NELLIE E. The Latin play recently given in the Western high school, Detroit. School R. 17:631–33. (N. '09.)

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[1] Abbreviations—Amer. Journ. of Psy., American Journal of Psychology; Amer. Phys. Educa. R., American Physical Education Review; Atlan., Atlantic Monthly; Dial, The Dial; Educa., Education; El. School T., Elementary School Teacher; Good Housekeep., Good Housekeeping; Journ. of Educa. (Bost.), Journal of Education (New England); Out., Outlook; Pedagog. Sem., Pedagogical Seminary; Pop. Educa., Popular Educator; Psycholog. Clinic, Psychological Clinic; Relig. Educa., Religious Education; School R., School Review; School Sci. and Math., School Science and Mathematics; Sci. Amer., Scientific American; Scrib. M., Scribner's Magazine.

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